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The Internal Revenue Service Post-of-Duty Location Modeling System: Users Manual Version 4.0

Paul D. Domich, Richard H. F. Jackson, and Marjorie A. McClain

U.S. DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
(Formerly National Bureau of Standards)
Center for Computing and Applied Mathematics
Gaithersburg, MD 20899

September 1988



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A Report to:
The Research Division
Internal Revenue Service
Washington, DC 20224

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75 Years Stimulating America's Progress
1913-1988

ABSTRACT

This report is a user's guide for a microcomputer package which was designed by the National Institute of Standards and Technology to assist the Internal Revenue Service in choosing locations for its posts-of-duty which will minimize costs to the IRS and to the taxpayer. The user may select the types of costs to be considered and may specify potential locations for new posts-of-duty. The system displays maps showing workload for a district, current post-of-duty locations and new post-of-duty locations. This manual provides hardware and software requirements for the system, installation procedures, data file formats, and detailed operating instructions.

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Section I: Introduction

A. Description of Reports

This paper is one of a series of reports documenting the Internal Revenue Service Post-of-Duty Location Modeling System, which was developed for the IRS Research Division by the Center for Computing and Applied Mathematics of the National Institute of Standards and Technology. The reports in the series are as follows.

1) The Internal Revenue Service Post-of-Duty Location Modeling System:
Final Report

This report describes the post-of-duty location problem and its mathematical model. It discusses the types of data which are considered in calculating costs, describes the methods used to solve the location problem, and gives a brief introduction to the computer implementation of the model. (NIST Contact: Paul D. Domich)

2) The Internal Revenue Service Post-of-Duty Location Modeling System:
User's Manual

This report is a user's guide for the post-of-duty location computer system. It gives hardware and software requirements, instructions for installing the system, descriptions of data files, and detailed instructions for operating the system. (NIST Contact: Marjorie A. McClain)

3) The Internal Revenue Service Post-of-Duty Location Modeling System:
Programmer's Manual for FORTRAN Driver

The post-of-duty location program is written in two sections of code, one in FORTRAN and the other in PASCAL. This report describes the FORTRAN driver which handles graphics displays and controls input and output for the solution procedure. The report includes an alphabetical list of the FORTRAN routines, describing the purpose, the calling sequence and the variables of each routine. (NIST Contact: Marjorie A. McClain)

4) The Internal Revenue Service Post-of-Duty Location Modeling System:
Programmer's Manual for PASCAL Solver

This report describes the second part of the post-of-duty location program, the PASCAL solver. It discusses the algorithms and data structures used to solve a location problem. (NIST Contact: Paul D. Domich)

B. Introduction to the System

The Internal Revenue Service Post-of-Duty Location System is a microcomputer package designed to assist IRS district planners in choosing locations for posts-of-duty (POD's) which will minimize costs to the IRS and to the taxpayer. The package uses color graphics in performing the following functions.

1) Displaying Workload

The user may choose the type of workload to be displayed, such as the number of returns filed. Then a district zip code map is drawn, with each zip code shaded according to the range of workload it generates.

2) Displaying Initial POD Sites

A district zip code map is drawn showing where POD's are currently located and also where new POD's could potentially be located. The user may make modifications to this information to specify POD's which may not be or must be in the set of POD's determined by the solution procedure.

3) Solving for Optimal POD Locations

Using the initial POD information specified by the user, the solution procedure calculates the cost of assigning each zip code to each current or potential POD. The cost includes travel costs associated with the workload of each zip code, office rental costs, and costs of opening new POD's or closing old POD's. The user may set parameters indicating what types of workload (such as Examination or Collection) should be included in the travel cost calculations. Also, weights may be assigned to pairs of zip codes and POD sites to scale travel costs. The user must specify the number of POD's desired in the solution. The solution procedure then determines the set of POD's which will result in the least total cost for the district.

4) Displaying Optimal POD Locations

A district zip code map is drawn showing where the new POD's determined by the solution procedure are located. Also, a report file may be generated which summarizes the problem specification and the solution. The report includes a list of which zip codes are to be assigned to which POD's, along with an estimate of staffing requirements for each POD.

5) Controlling Display of Maps

On any of the district zip code maps mentioned above, the user may zoom in on a small region, back up to a larger region, locate a specified zip code on the map, or find the zip code number of an area on the map.

The remaining sections of this manual describe how to set up and use the POD location system. Section II contains the computer hardware and software requirements. Section III explains the procedure for installing the system and describes the format of required data files. Section IV contains detailed instructions on how to operate the system.

C. User Assistance and Future Releases

Users should address any questions concerning the POD location system to their regional representatives. The names of regional representatives can be obtained by calling John Brown, National Office Facilities Management (Space Management), at FTS 535-9870.

Future releases of the system, including updated workload and map data, are expected to be distributed annually in April or May. Distribution will take place through the regional representatives.

Section II: Computer Requirements

A. Hardware

The POD location system has been designed to run on an IBM-PC XT or AT equipped with a math coprocessor and with one of the following types of displays.

1) IBM Enhanced Graphics Adapter with Enhanced Color Display (EGA)

This display has a screen size of 640x350 pixels and uses 16 colors. Text, lines and marker symbols are drawn in high resolution, and shaded regions of maps are filled using solid colors. The system requires at least 128KB of graphics memory, rather than the standard 64KB. This extra graphics memory is necessary in order to display 16 distinct colors; without enough memory, colors which are different in the graphics program may look the same on the screen (so, for example, a shaded map may appear to be all one color).

2) IBM Color Graphics Monitor Adapter (CGA)

This display, used in medium resolution mode, has a screen size of 320x200 pixels and uses four colors. Text characters are larger than on the enhanced display, so menus take up a greater proportion of the display screen. Shaded regions of maps are filled using cross-hatching.

The system requires 640KB of memory and approximately 1.5MB of disk space. A printer is desirable, but not necessary.

The system may also run on IBM-compatible machines, but due to the use of graphics device drivers (see Section III Part A) for the specific displays listed above, unpredictable results may occur if other displays are used. The system has been successfully tested on a Compaq Deskpro 286 with a Princeton Graphics Quadchrome monitor, on a Compaq portable, and on an IBM PS/2 Model 60.

Note: Reference to a tradename or product in this report does not imply endorsement by the National Institute of Standards and Technology.

B. Software

Users of the POD location system will be provided with all the required executable code and graphics device drivers for the system. The only other software requirement is IBM-PC DOS (Version 2.1 or later).

Programmers who want to be able to make changes in the system will need additional software, such as source code, IBM Professional FORTRAN, Turbo PASCAL, and the IBM Graphical Kernel System. See "The Internal Revenue Service Post-of-Duty Location Modeling System: Programmer's Manual for FORTRAN Driver" and "The Internal Revenue Service Post-of-Duty Location Modeling System: Programmer's Manual for PASCAL Solver" for further details.

Section III: Setting Up the System

This section provides instructions for installing the POD location system programs and data files on a PC hard disk. The instructions given here are of a general nature applying to users in every district. More explicit installation instructions specific to a given district may be provided with the distribution disks. If so, such instructions override the installation instructions in this manual.

A. Contents of the Distribution Disks

The following required files should be provided on the distribution disks.

1. INIT_VDI.EXE
2. VDIY010.SYS
3. VDIY004.SYS
4. VDI.SYS
5. LOCATE.BAT
6. DRIVER.EXE
7. SOLVER.COM
8. PODSITE.id
9. WORKLOAD.id
10. OUTLINE.id
11. ZIPCODE.id
12. CENTROID.id

The "id" extension in the last five file names should be replaced by the two-digit district identification number. The following optional files should also be provided on the distribution disks.

1. CONFIG.SYS
2. AUTOEXEC.BAT
3. DISTRICT
4. PONAMES.id
5. ADJACENT.id

The files INIT_VDI.EXE, VDIY010.SYS, VDIY004.SYS, and VDI.SYS are device driver files which link the graphics portion of the POD location system to the type of display device being used (EGA or CGA). The device drivers are initialized in the CONFIG.SYS and AUTOEXEC.BAT files.

The files LOCATE.BAT, DRIVER.EXE, and SOLVER.COM contain the POD location system programs. The batch file LOCATE.BAT calls DRIVER.EXE and SOLVER.COM and is used to execute the system.

The files DISTRICT, PONAMES.id, PODSITE.id, WORKLOAD.id, OUTLINE.id, ZIPCODE.id, CENTROID.id, and ADJACENT.id contain IRS data and geographic data for a given district. These files are described more fully in Part C of this section.

B. Installing the System

To install the POD location system on a PC hard disk, create a subdirectory for the system, make it the current directory, and copy the contents of each distribution disk into the directory. The following example of this process assumes that the system directory is called "POD" (any other name may be substituted) and that the distribution disks are placed in the A drive.

```
C:
MD\POD
CD\POD
COPY A:*. *   (Do this step for each distribution disk.)
```

To complete the installation process, it is necessary to initialize the graphics device drivers in the CONFIG.SYS and AUTOEXEC.BAT files in the root directory. These files contain commands which are loaded by the computer when it is turned on. To install the CONFIG.SYS and AUTOEXEC.BAT files, copy the sample CONFIG.SYS and AUTOEXEC.BAT files from the distribution disks into the root directory, after making backup copies of any previously existing CONFIG.SYS and AUTOEXEC.BAT files there. The sample files should contain the following statements, assuming that the device drivers are in a subdirectory called "POD" and that the DOS file ANSI.SYS is in a subdirectory called "DOS".

CONFIG.SYS

```
BREAK ON
FILES=10
BUFFERS=10
DEVICE=C:\DOS\ANSI.SYS
DEVICE=C:\POD\VDIDY010.SYS /G:CRT   (for an EGA display)
DEVICE=C:\POD\VDIDY004.SYS /G:CRT   (for a CGA display)
DEVICE=C:\POD\VDI.SYS
```

AUTOEXEC.BAT

```
C:\POD\INIT_VDI
```

Some modifications to these statements may be necessary in order to correctly specify directory names and other information to correspond to a particular computer configuration. After setting up the CONFIG.SYS and AUTOEXEC.BAT files, restart the computer (by pressing <ctrl-alt-del>) for the new files to take effect. This completes the installation process.

The following additional notes concerning the graphics device drivers, CONFIG.SYS file, and AUTOEXEC.BAT file may be useful.

- 1) FILES=10 and BUFFERS=10 are values suggested by the Professional FORTRAN manual for use with Professional FORTRAN programs. Larger values may be substituted.

- 2) The file ANSI.SYS is provided with DOS, so its path name in the CONFIG.SYS file should correspond to the user's DOS directory.
- 3) VDI.SYS must be the last device listed in the CONFIG.SYS file.
- 4) It is not actually necessary to include INIT_VDI in the AUTOEXEC.BAT file. It may be executed at any time before running the POD location system.
- 5) An EGA display can be made to emulate a CGA display by using the VDIDY004.SYS device driver. Both device drivers can be listed together in the CONFIG.SYS file; the one listed last will be the default display mode used by the POD location system. To switch to the other device driver, type SET DISPLAY=C:\POD\VDIDYxxx.SYS (where "xxx" is either "004" or "010") before running the program.
- 6) The DOS <shift-printscreens> command for making printed copies of a graphics screen will only work with the VDIDY004 device driver. It does not copy EGA screens. (Type GRAPHICS before running the POD location system if printed copies of graphics screens are desired; see the DOS manual for more information.)
- 7) After making any changes to the CONFIG.SYS or AUTOEXEC.BAT files, the computer must be restarted for the changes to take effect.
- 8) If the device drivers have not been properly initialized, the message "CANNOT OPEN WORKSTATION" may appear when trying to run the POD location system.

C. Description of Data Files

The remainder of this section describes the contents of the data files required by the POD location system. It is not necessary to read this material to be able to run the system, but it may be helpful in understanding how the system works and in making modifications to the data.

Each data file has a descriptive name followed by a period and a two-digit extension representing the district office number. For example, ZIPCODE.59 is the name of the file containing zip code boundary coordinates for the Jacksonville District. In this manual, "id" is substituted for the district office number.

The data files used by the POD location system can be divided into two categories: (1) geographic data files used to draw maps and (2) IRS data files used to initialize and solve a location problem. The geographic files OUTLINE.id, ZIPCODE.id, and CENTROID.id are essential to the operation of the system. They contain state outline coordinates, state zip code boundary coordinates, and zip code centroid (geographic center) coordinates, all stored in binary form. The remaining geographic files, DISTRICT, ADJACENT.id, and PONAMES.id, are optional. The file DISTRICT contains only the two-digit district office number; if the system does not find this file, it asks the user for the district office number and then automatically creates a DISTRICT file. The file ADJACENT.id contains zip code adjacency

information in binary form; it is used only for coloring the solution map (see Section IV Part F). The file PONAMES.id contains a list of state zip code numbers and their corresponding post office names; this file is never used by the POD location system but is provided for the user's information. Updates to the geographic data files will be provided annually as the post office changes its zip codes. The user should not attempt to make any alterations to these files.

Two IRS data files, PODSITE.id and WORKLOAD.id, are also essential to the operation of the POD location system. The format of these files is as follows.

PODSITE.id

The purpose of this file is to maintain a list of the zip codes and associated costs of all POD sites which currently exist in the district and also of any potential new POD sites. The first line of the file should contain seven items:

- (1) the total number of possible POD sites (current and potential) for the district,
- (2) the office space requirement (given as square feet per TDI-TDA),
- (3) the travel cost (dollars per mile),
- (4) the travel distance limit (miles), i.e., the maximum one-way distance that a person would be expected to travel between a zip code and a POD site,
- (5) the number of Examination personnel for the district,
- (6) the number of Collection personnel for the district, and
- (7) the number of other personnel for the district.

Each remaining line of the file (one line per POD site) should contain three items:

- (1) the five-digit zip code of the site,
- (2) the opening or closing cost for a POD at the site (dollars), and
- (3) the rental cost for office space at the site (dollars per square foot per year).

To distinguish between current and potential POD sites, a minus sign should be placed before the zip codes of current POD sites. This also determines whether the second number is an opening or a closing cost; current POD sites have closing costs and potential POD sites have opening costs.

The following example of a PODSITE.id file shows nine POD sites, six of which are current POD sites.

```
9 .590 .210 80. 100 100 100
-20001 20000. 18.0
-20003 20000. 7.0
 20004 150000. 9.5
 20007 150000. 6.0
-20010 20000. 12.0
-20013 20000. 6.0
 20014 150000. 3.5
-20015 20000. 14.0
-20018 20000. 12.0
```

Numbers in the file should be separated by spaces or commas, and the zip codes should be listed in sequential order.

The user should customize the PODSITE.id file for his or her own district. Estimates should be made for opening/closing costs by zip code in the user's district, as well for the office space costs, the travel distance limit, and the staff totals. Most of the values in the first line of the file can be changed interactively while running the POD location system (see Section IV Part E); all other values must be changed within the PODSITE.id file itself using a text editor such as Wordstar.

WORKLOAD.id

The purpose of this file is to provide a list of all the zip codes in the district with their annual workloads in each of 36 categories (see below for category descriptions). The beginning of the file provides other related information:

Line 1 -

The first line should contain a zero entry followed by the 36 IRS trip factors, one for each category of workload. (An IRS trip factor is the average number of trips an IRS employee must make for each case in a particular category.) The user should revise this data for his or her own district.

Line 2 -

The second line contains a zero entry followed by the 36 taxpayer trip factors (the average number of trips a taxpayer must make per case). The user should revise this data for his or her own district.

Line 3 -

The third line contains a zero entry followed by the 36 staffing factors (the relative amount of time required to process a case in each workload category). This data was developed by the National Office but may be changed if the user desires.

Each remaining line of the file (one line per zip code, listed in sequential order) should contain a five-digit zip code followed by 36 numbers giving the workload for that zip code in each of the following categories.

- 1) BMF Exam - TY85 1120 Returns above "Optimal" DIF Score
- No Balance Sheet
- 2) BMF Exam - TY85 1120 Returns above "Optimal" DIF Score
- < \$100,000
- 3) BMF Exam - TY85 1120 Returns above "Optimal" DIF Score
- \$100,000 to \$1M
- 4) BMF Exam - TY85 1120 Returns above "Optimal" DIF Score
- \$1M to \$10M
- 5) BMF Exam - TY85 1120 Returns above "Optimal" DIF Score
- > \$10M
- 6) BMF Exam - TY85 1120S Returns Filed - < \$100,000
- 7) BMF Exam - TY85 1120S Returns Filed - \$100,000 to \$1M
- 8) BMF Exam - TY85 1120S Returns Filed - \$1M to \$10M
- 9) BMF Exam - TY85 1120S Returns Filed - > \$10M
- 10) BMF Exam - TY85 1065 Forms Filed
- 11) BMF Exam - TY85 720 Forms Filed
- 12) BMF Exam - TY85 706 Forms Filed
- 13) BMF Exam - TY85 2290 Forms Filed
- 14) BMF Exam - TY85 730 Forms Filed
- 15) IMF Exam - TY85 Returns above "Optimal" DIF Score - Class 1
- 16) IMF Exam - TY85 Returns above "Optimal" DIF Score - Class 2
- 17) IMF Exam - TY85 Returns above "Optimal" DIF Score - Class 3
- 18) IMF Exam - TY85 Returns above "Optimal" DIF Score - Class 4
- 19) IMF Exam - TY85 Returns above "Optimal" DIF Score - Class 5
- 20) IMF Exam - TY85 Returns above "Optimal" DIF Score - Class 6
- 21) IMF Exam - TY85 Returns above "Optimal" DIF Score - Class 7
- 22) IMF Exam - TY85 Returns above "Optimal" DIF Score - Class 8
- 23) IMF Exam - TY85 Returns above "Optimal" DIF Score - Class 9
- 24) IMF Exam - TY85 Returns above "Optimal" DIF Score - Class 10
- 25) IMF Exam - TY85 Returns above "Optimal" DIF Score - Class 11
- 26) IMF Exam - TY85 Returns above "Optimal" DIF Score - Class 12
- 27) BMF Collection - Modules with Active TDI in CY87
- 28) BMF Collection - Modules with Active TDA in CY87
- 29) IMF Collection - Modules with Active TDI in CY87
- 30) IMF Collection - Modules with Active TDA in CY87
- 31) IMF Returns Filed in CY87
- 32) BMF Returns Filed in CY87
- 33) IMF Exams Closed in CY87
- 34) BMF Exams Closed in CY87
- 35) TDI's Issued in CY87
- 36) TDA's Issued in CY87

Only the first thirty workload data types are used by the POD location system to choose the best POD sites. Optimal rather than existing workload is used since existing workload is often a function of the current location of POD's and staff rather than the optimal location. The remaining six data types (31-36) are used only in the workload display section of the system (see Section IV Part C) for the user's information. Consequently, the trip factors and staffing factors corresponding to these data types can be set to zero (or any number) since they will have no effect on the output of the system.

It is permissible for the user to change the numbers in the WORKLOAD.id file, as long as the file format remains as described above. However, the user should not attempt to add or delete zip codes from the workload file, since this may invalidate information in the geographic file ADJACENT.id. Updates to the WORKLOAD.id file will be provided annually, based on data for the prior calendar year.

To summarize, the following data files must exist to run the POD location system.

- 1) OUTLINE.id (state outline file)
- 2) ZIPCODE.id (zip code boundary file)
- 3) CENTROID.id (centroid file)
- 4) PODSITE.id (POD file)
- 5) WORKLOAD.id (workload file)

Section IV: Using the System

A. Overview

This introduction gives a general overview of the steps a user should go through to solve a location problem. Detailed instructions for each step are provided in later parts of this section. The overview also describes how maps are used in the system and explains how to use the cursor to locate zip codes and to zoom in on maps.

Steps in Solving a Location Problem

(Before the system is used for the first time, it must be properly installed. In particular, graphics device drivers must be initialized in the user's CONFIG.SYS and AUTOEXEC.BAT files. See Section III Part B for information on how to do this.)

1) **Enter the system.**

Type LOCATE to enter the system. If requested, type in the district number. Wait for the top-level menu to appear. (See Part B for more information on entering the system.)

2) **Display workload.**

This step may be repeated at any time, or it may be skipped. Select the function for displaying workload from the top menu. Choose the category of workload to be displayed. A state map will appear which can be zoomed in on to show zip codes shaded according to their workloads. (See Part C for more information on displaying workload.)

3) **Display and initialize POD information.**

This step is optional. From the top menu, select the function for displaying and modifying initial POD sites. A state map will appear with asterisks showing where POD's are currently located. Zoom in on the map to an area of interest, and then color in zip codes to indicate whether they are to be considered as currently existing POD sites, potential new POD sites, or fixed POD sites which cannot be moved. Zip codes which are not colored will not be considered as possible POD sites. (See Part D for more information on displaying POD information.)

4) **Solve for best POD locations.**

From the top menu, select the function for solving for optimal POD locations. Set options as requested to select categories of workload to be considered in the cost calculation and to choose weights for IRS and taxpayer costs. Travel difficulty factors may be entered for pairs of zip codes and POD sites which are separated by geographic barriers. Choose the number of POD's desired in the solution. The solution procedure will then begin, and a summary of the stages of the process

will appear on the screen. (See Part E for more information on and solving a location problem.)

5) **Display solution.**

This step is optional. Select the function for displaying optimal POD locations from the top menu. A state map will appear with asterisks showing where POD's have been placed by the solution procedure. Zoom in on the map to areas of interest. (See Part F for more information on displaying a solution.)

6) **Generate report file.**

From the top menu, select the function for reporting zip code and staff assignments. This option creates a report file which contains a complete summary of the current POD location problem. For each POD in the solution, the report lists all the zip codes which should be assigned to it, along with an estimate of the staff required for its workload. The report file may be printed out when exiting from the system. (See Part G for more information on the report file.)

7) **Exit from the system.**

From the top menu, select the function for exiting from the system. Print out the report file, or examine it with an editor such as Wordstar. (See Part H for more information on exiting from the system.)

Use of Maps

In several of the steps listed above, maps are drawn to display information. Although the type of information is different at each step, the procedure for manipulating the maps is the same. The user may zoom in on a small region, back up to a previous map, locate a specified zip code number, or find the zip code number of a specified area on the map.

The first map drawn always shows the outline of the state and centroids (geographic centers) of selected zip codes, but no zip code boundaries. (The reason for not including zip code boundaries at this level is that many of them would be too small to be distinguished and it would take a very long time to draw them for the whole state.) A menu appears to the left of the map giving the user several choices on how to proceed.

1) **Exit**

This option returns the user to the top menu.

2) **Zoom**

This option allows the user to zoom in on the map to display zip code boundaries in a small region. When this option is chosen, instructions appear in the menu area telling how to use the cursor to draw a box around the area to be enlarged. First a crosshair (+) cursor appears in the center of the screen, which can be moved using the arrow keys and the

"home", "end", "page up" and "page down" keys on the right side of the keyboard (or with a mouse). (If the cursor keys do not work, check to be sure the "num lock" key is off.) Move the cursor to one corner of the area to be enlarged; then press return (↵) to enter the coordinates of this point into the computer. (The cursor can move in either large or small increments. Pressing the "insert" key toggles between the two modes.) Next, move the cursor to locate the diagonally opposite corner of the box. This time the box is actually drawn on the screen. Then press return (↵) to enter this point.

The old map will be erased from the screen, and a new map showing zip codes in the boxed area will be drawn. A new menu will appear on the left side (see below). If a mistake was made in entering the box corners (for example, if both corners were the same point), the message "ZOOM ERROR: DO YOU WANT TO TRY AGAIN?" will appear. If the answer is "yes", the user may start over, again entering diagonal corners of the box. If the answer is "no", the previous menu reappears on the screen.

3) Mark Zip Code

When this option is chosen, the user is asked to type in a zip code number. If the zip code exists, its location will be marked by an "X" on the state map. Otherwise, the message "NOT FOUND" will appear. This option is available only for the full state map. The "X" disappears when the user zooms in on the map.

After the second option above (Zoom) is chosen, a new menu appears on the left side of the screen with the following options.

1) Exit

This option returns the user to the top menu.

2) Zoom

This option allows the user to zoom in on a specified area of the current map. The procedure for drawing a box around the area is the same as given above. After the new map has been drawn, the same menu of options appears. The user may zoom as many times as desired.

3) Back Up

This option redraws the previous map and its display menu. Only one level of backing up is allowed. For example, if five zooms had been done, only the fourth map could be redisplayed. However, it is always possible to return to the state outline map and then zoom in again.

4) Full State

This option redraws the state outline map with zip code centroids.

5) Map Key

This option displays a key which defines the colors on the map. Two further options are available at this level. First, the user may exit from the map key and return to the menu of display options. Second, the user may move the cursor to locate a zip code region on the map and have its five-digit number displayed in the lower left corner of the screen.

The cursor is moved with the arrow keys and the "home", "end", "page up" and "page down" keys on the right side of the keyboard (or with a mouse). Pressing the "insert" key makes the cursor toggle between large and small increments. To locate a zip code, move the cursor near the centroid of the zip code and press return (↵). The five-digit zip code number will be written at the bottom of the menu area. If the cursor is too far away from a centroid, the message "ZIP NOT FOUND" will be written instead.

It is important to keep in mind that the system does not recognize the boundary lines on the map, so it is not necessarily enough merely to have the cursor in the correct zip code region. The cursor must be positioned close to the centroid of the region of interest. The zip code printed is that of the nearest centroid to the cursor, whether it is in the same region as the cursor or not.

(Note: Occasionally, instead of a zip code number the message "ZEROZIP" appears. This occurs for areas which have no official zip codes.)

In addition to the two options discussed above, other options are available on this menu for the POD initialization map to change the colors of zip codes. See Part D for information on how to do this.

The remainder of this report provides descriptions of menus and detailed instructions for each step used in solving a POD location problem.

B. Entering the System

To enter the POD location system, switch to the directory containing the system files (using the DOS "Change Directory" command) and type LOCATE. A title page will appear on the screen. (If, instead, an error message "4001" appears and the program begins to cycle erratically, probably the computer does not have a math coprocessor. See Section II Part A for hardware requirements.) Then, if prompted, enter the two-digit district office identification number. (This number must be the same as the two-character extension for each of the system data file names. See Section III Part A.) The district number should only need to be entered the first time the system is used. It is then saved in a file called DISTRICT for automatic use in subsequent sessions. (The DISTRICT file should be provided on the distribution disks, in which case the district number prompt will never occur.)

If a report file exists from a previous session, the system will then ask whether the report is to be overwritten. (See Parts G and H for information on the report file.) If the user answers "yes", the old report file will be replaced by a new report on the current session. If the user answers "no", the new report will be appended to the old report file.

The message "Working ..." will then appear, followed by a brief pause. (If the pause lasts for more than a minute or if the message "CANNOT OPEN WORKSTATION" appears, check for device driver errors in the AUTOEXEC.BAT or CONFIG.SYS files. See Section III Part B.) Then the top-level menu will appear on the screen, as shown in Figure 1.

IRS POST-OF-DUTY LOCATION SYSTEM
F1 - Exit.
F2 - Display workload.
F3 - Display or modify initial POD sites.
F4 - Solve for optimal POD locations.
F5 - Display optimal POD locations.
F6 - Report zip code and staff assignments.

Figure 1. Top-level menu.

This menu lists the steps used to solve a POD location problem, along with a function key number for each step. To make a selection from the menu, just push the corresponding function key (no return (↵) is necessary). The following is a brief description of each of the choices in the top menu. For a more complete description, see the subsection listed in parentheses.

F1 - Exit (Part H)

Exits from the POD location system.

F2 - Display workload (Part C)

Draws a map showing workload for each zip code.

F3 - Display or modify initial POD sites (Part D)

Draws a map showing where POD's are currently located and also where new POD's are allowed to go. The user may alter this information by coloring the map, and the data is saved for use by the solution algorithm (see F4).

F4 - Solve for optimal POD locations (Part E)

Solves the location problem initialized using F3.

F5 - Display optimal POD locations (Part F)

Draws a map showing the new POD locations determined using F4.

F6 - Report zip code and staff assignments (Part G)

Generates a report file which summarizes the input data and the solution to the current location problem.

C. Displaying Workload

The F2 function in the top menu is used to display a map showing workload for each zip code in the district. Before drawing the map, the system will ask the user to choose the category of workload to be displayed from the following list.

- 1) Examination
- 2) Collection
- 3) A single column of the workload file
- 4) A user-specified combination of columns

Type the number of the desired category. If category 1 is selected, total "optimal" Exam workload (columns 1-26 from the file WORKLOAD.id) will be displayed. (See Section III Part C for a description of individual workload columns.) If category 2 is selected, total Collection workload (columns 27-30) will be displayed. If category 3 is selected, the user will be prompted to type in the number of the column to be displayed (a number from 1 to 36). If category 4 is selected, a horizontal list of column numbers will appear. The user should type a "1" under each column to include. The workloads in these columns will be added together for the display, so the user should take care that the columns chosen are compatible. That is, it does not make sense to add BMF returns to IMF TDI's, for example.

The workloads for each zip code are then read in from the file WORKLOAD.id. While the file is being read, the system compares the zip codes in the workload file with the zip codes in the master zip code list. (The master list consists of all the zip codes in the boundary file, which will be used to draw the map.) If any zip codes appear in the workload file but not in the master list, they will be ignored. If any zip codes appear in the master list but not in the workload file, they will be drawn as blank areas on the workload map. (In particular, zip codes from other districts in the same state will be drawn as blank areas.)

Next, the system must decide what color to associate with each workload value. By default, it looks at the minimum and maximum workload which it read from the file, divides this span into six equal ranges, and lists the ranges on the screen, as in the following example.

```
NUMBER OF RANGES: 6
LOWER LIMIT OF RANGE #1: 0
UPPER LIMIT OF RANGE #1: 11
UPPER LIMIT OF RANGE #2: 22
UPPER LIMIT OF RANGE #3: 34
UPPER LIMIT OF RANGE #4: 45
UPPER LIMIT OF RANGE #5: 56
UPPER LIMIT OF RANGE #6: 68
```

In this example, the system would assign one color to zip codes with workloads between 0 and 11, a second color to those between 11 and 22, a third color to those between 22 and 34, and so on, for a total of six colors. However, before proceeding with this, the system asks if the user wishes to change these range assignments. If so, it next asks how many ranges (colors) are desired, which may be any number from 2 through 6. The

system lists the new equally-spaced ranges on the screen. The user may then proceed to change the range limits, by entering each range in order when prompted. (Note that the user may not change the lower limit of the first range or the upper limit of the last range, since these values are determined by the actual minimum and maximum workload read from the data file.) Once the user has entered acceptable workload ranges, the system proceeds to assign a color to each zip code in the district according to which range its workload lies in.

After the workload file has been read and colors have been calculated, a map showing only the state outline and small boxes for zip code centroids is drawn. Centroids are drawn only for zip codes which appear in the workload file. No zip code boundaries are drawn at this level. On an EGA display, the centroids are drawn in six different colors, with brighter colors indicating higher workloads. On a CGA display, all the centroids are drawn in yellow; the user must zoom in on the map in order to see the workload. To the left of the state map, a menu of display options appears on the screen (see Figure 2).

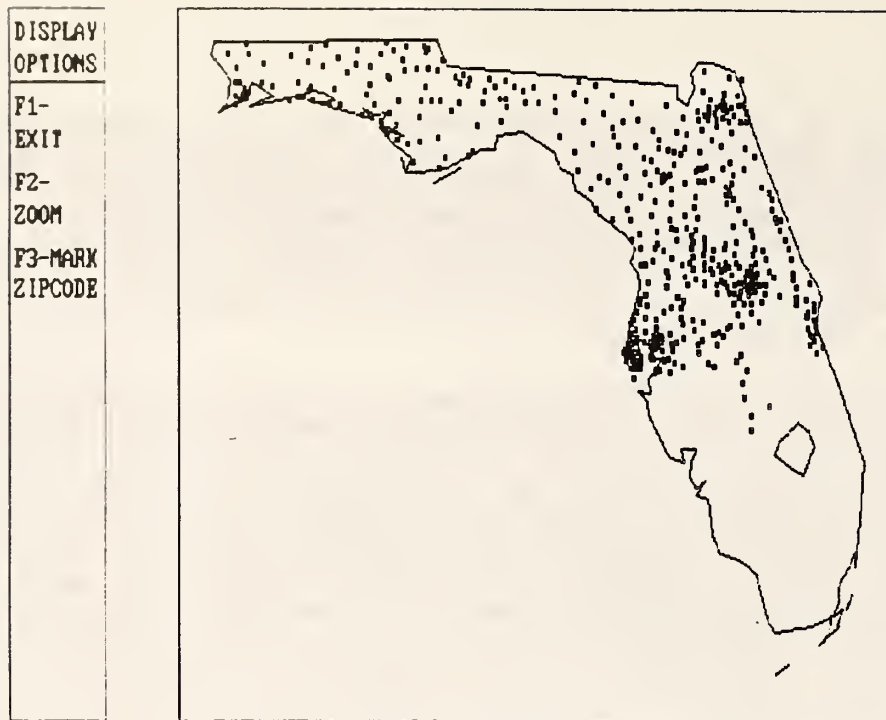


Figure 2. Full state map display menu.

The menu choices are discussed below.

F1 - Exit

Exits from the workload map. The user is then given the option of redisplaying the map with different range limits. (This may be desirable if, for example, the user notices that most of the zip codes fall into only one or two of the original ranges.) Otherwise, the system exits from the workload display mode and returns to the top menu.

F2 - Zoom

Zooms in on a specified area of the map to display workload there. See Part A for a complete description of how to use the cursor to draw a box around the area. A new map showing zip code boundaries in the boxed area will be drawn, and a new menu will appear (see below).

F3 - Mark Zip Code

Allows the user to type in a zip code number and have its location marked on the map. See Part A for more information.

After choosing F2 from the full state display menu, the menu of display options shown in Figure 3 will appear.

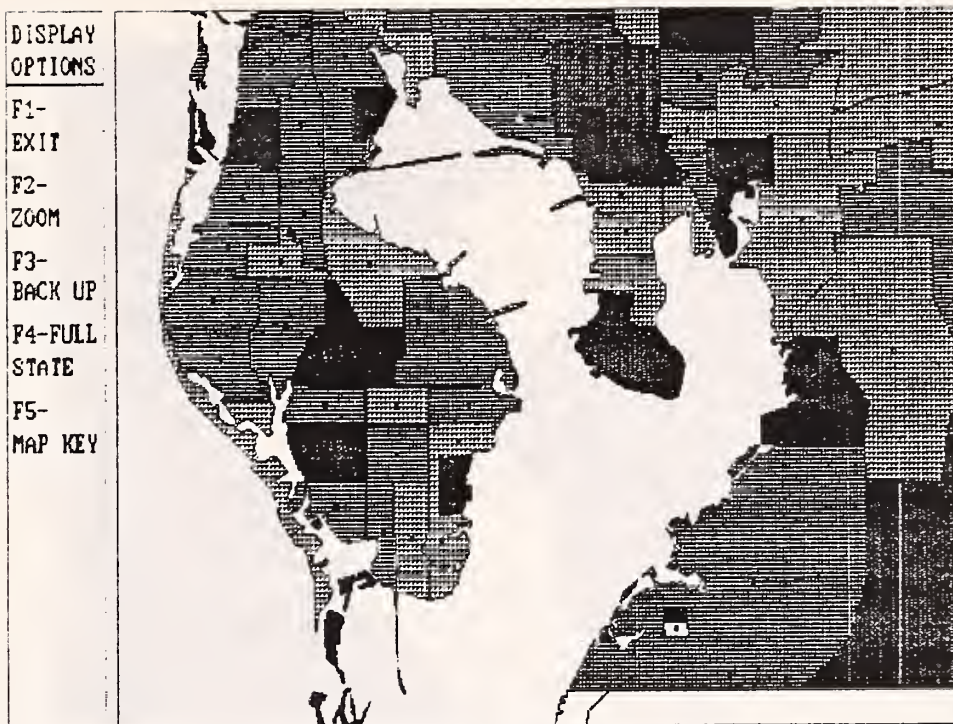


Figure 3. Zip code map display menu.

The options are described below.

F1 - Exit

Exits from the workload map. The user is then given the option of redisplaying the map with different range limits. (This may be desirable if, for example, the user notices that most of the zip codes fall into only one or two of the original ranges.) Otherwise, the system exits from the workload display mode and returns to the top menu.

F2 - Zoom

Zooms in on a specified area of the current map. See Part A for a complete description of how to use the cursor to draw a box around the area. After the new map has been drawn, the same menu of display options appears. The user may zoom as many times as desired.

F3 - Back Up

Redraws the previous map and its display menu. Only one level of backing up is allowed.

F4 - Full State

Redraws the state outline map with zip code centroids. The full state display menu also reappears.

F5 - Map Key

Displays the map key shown in Figure 4 defining what the zip code colors mean.



Figure 4. Workload key.

There is a color for each of the possible workload ranges, listed in order from the lowest workload to the highest workload. The number written in each color bar is the upper limit of the workload range represented by that color. Two menu options exist.

- F1** - Exits from the workload key and returns to the menu of display options.
- F2** - Allows the user to find the zip code number of an area on the map located by the cursor. The zip code number is displayed in the lower left corner of the screen. (The procedure for using the cursor to locate a zip code is described in Part A.)

D. Displaying or Modifying Initial POD Sites

The F3 function in the top menu is used to display a map showing current POD sites and other potential POD sites in the district. This information is read from the file PODSITE.id. The user is allowed to make modifications by changing the colors on the map. The modified POD information is saved for use later by the solution algorithm.

Before the map is drawn, the system checks to see that all POD zip codes appear in the master list of zip codes obtained from the boundary file. If any mismatches occur, a message will appear on the screen and the POD will be ignored by the system. The user should check on the accuracy of the file PODSITE.id.

After the zip codes have been checked, a map showing only the state outline and centroids of certain zip codes is drawn. On an EGA display, centroids of current POD sites are drawn as red asterisks and centroids of other potential POD sites are drawn as small blue boxes; other zip code centroids are not drawn. On a CGA display, centroids of current POD sites are drawn as red asterisks and centroids of potential POD sites are drawn as yellow boxes. A menu of display options appears on the left side of the screen (see Figure 5).

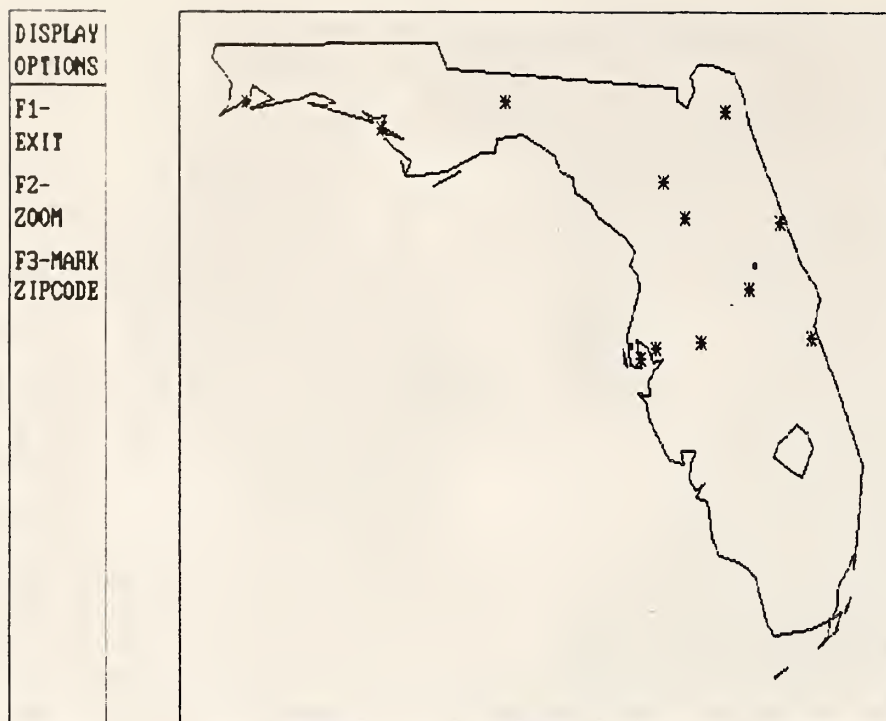


Figure 5. Full state map display menu.

The menu choices are discussed below.

F1 - Exit

Exits from the POD initialization mode and returns to the top menu. The current POD set-up is saved to be used later by the solution algorithm.

F2 - Zoom

Zooms in on a specified area of the map to display POD information there. See Part A for a complete description of how to use the cursor to draw a box around the area. A new map showing zip code boundaries in the boxed area will be drawn, and a new menu will appear (see below).

F3 - Mark Zip Code

Allows the user to type in a zip code number and have its location marked on the map. See Part A for more information.

After choosing F2 from the full state display menu, the menu of display options shown in Figure 6 will appear.

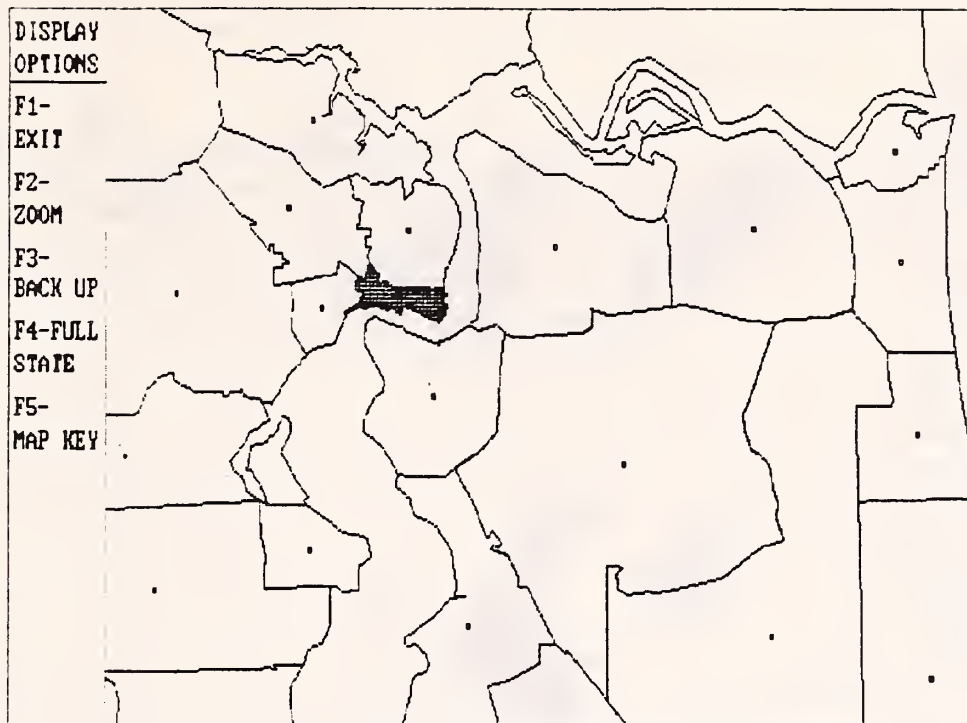


Figure 6. Zip code map display menu.

The options are described below.

F1 - Exit

Exits from the POD initialization mode and returns to the top menu. The current POD set-up is saved to be used later by the solution algorithm.

F2 - Zoom

Zooms in on a specified area of the current map. See Part A for a complete description of how to use the cursor to draw a box around the area. The same menu will appear after the new map is drawn, and the user may zoom as many times as desired.

F3 - Back Up

Redraws the previous map and its display menu. Only one level of backing up is allowed.

F4 - Full State

Redraws the state outline map with zip code centroids. The full state display menu also reappears.

F5 - Map Key

Displays the map key shown in Figure 7 defining what the zip code colors mean.

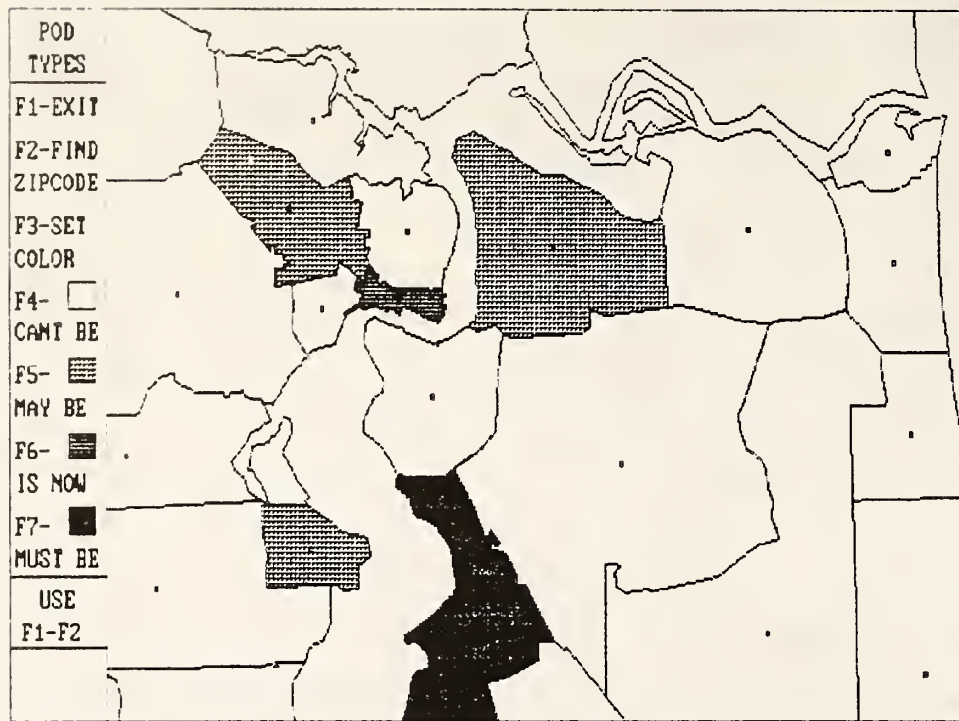


Figure 7. POD map key.

A function key is associated with each color to allow colors to be changed on the map. The functions are as follows.

- F1** - Exits from the map key and returns to the menu of display options.
- F2** - Allows the user to find the zip code number of an area on the map located by the cursor. The zip code number is displayed in the lower left corner of the screen. (The procedure for using the cursor to locate a zip code is described in Part A.)
- F3** - Enters the mode for changing the color of a zip code on the map. The zip code must have been located already using F2.
- F4** - Sets a zip code to be a site which is not allowed to have a POD. The coloring mode must have been entered using F3.
- F5** - Sets a zip code to be a site which is allowed to have a POD but does not currently have one. The coloring mode must have been entered using F3.
- F6** - Sets a zip code to be a site which currently has a POD. The coloring mode must have been entered using F3. Current POD sites are allowed to be removed by the solution algorithm.
- F7** - Sets a zip code to be a site which must have a POD. The coloring mode must have been entered using F3. Sites which must have a POD are fixed and will not be removed by the solution algorithm.

To summarize, the map originally shows current POD sites and other potential POD sites as read from the file PODSITE.id. The user may fix

a POD site or make other changes by first locating the zip code with the cursor (F2), entering the coloring mode (F3), and then choosing the correct color (F4, F5, F6 or F7). A message is always given at the bottom of the menu area telling which functions keys can currently be used; if any other key is pushed it will be ignored.

E. Solving for Optimal POD Locations

The F4 function in the top menu is used to solve a POD location problem given an initial configuration of current, potential and fixed POD sites, as set up using the F3 function. (If F3 was not done first, the solution proceeds using the initial configuration given in the file PODSITE.id.) If the system detects any POD sites for which it does not have opening/closing costs or office rental costs, the user will be prompted to enter this information.

After F4 is pushed, the system will allow the user to set various parameters to be used in calculating costs. A list of default parameter settings will appear on the screen, similar to the following.

#	ITEM	POSSIBLE	ACTUAL
1	IMF EXAMINATION	0 OR 1	1
2	IMF COLLECTION	0 OR 1	1
3	BMF EXAMINATION	0 OR 1	1
4	BMF COLLECTION	0 OR 1	1
<hr/>			
1 - INCLUDED IN COST CALCULATION, 0 - NOT INCLUDED			
<hr/>			
5	TAXPAYER TRAVEL COST WEIGHT		1.000
6	IRS TRAVEL COST WEIGHT		1.000
7	MAXIMUM TRAVEL DISTANCE		80.000
8	OFFICE SPACE REQUIREMENT		0.590
9	DOLLAR COST PER MILE TRAVELED		0.210
10	TOTAL AVAILABLE EXAMINATION STAFF		100
11	TOTAL AVAILABLE COLLECTION STAFF		100
12	TOTAL AVAILABLE OTHER STAFF		100

The first four items indicate which categories of workload should be included in the cost calculation; a value of 1 means the category is included and a value of 0 means it is not included. The next two items are weights to be assigned to IRS employee travel costs and taxpayer travel costs. For example, setting the IRS weight to 0 and the taxpayer weight to 1 would cause the solution procedure to consider only costs to the taxpayer. The weights can have any nonnegative decimal value. The seventh item on the parameter list is the maximum distance that a person would be expected to travel between a zip code and a POD. The value listed (in this example, 80 miles) is read from the file PODSITE.id. The distance limit has the effect of cutting down on storage space and on the running time of the solution procedure, since zip codes and POD sites separated by too large a distance can be eliminated from consideration. The eighth item is the office space requirement, given as square feet per TDI-TDA. The ninth item is the travel cost (dollars per mile), and the final three items give the number of Exam, Collection, and other staff people available for assignment to the POD's in the district.

The user should carefully review the parameter settings to determine whether they correctly reflect the situation in the user's district. The system will then ask whether the user wishes to change any of the default parameter settings. If the answer is "yes", the user is asked to enter the

number of the item to be changed and its new value. These should be typed on one line, separated by a space. The new value will then appear in the parameter list, and the user may proceed to make further changes. Changes to parameters 7-12 may be made permanent when exiting from the system. (See Section H for more information.)

Next, the system will ask if the user wants to change any travel difficulty factors. These are weights which are assigned to pairs of zip codes and POD's to scale their travel costs. This is especially useful in cases where, for example, a zip code and a POD site are close together (in terms of the distance between their centroids) but are separated by some geographic barrier (such as a bay or mountain range) which makes travel between them difficult. By assigning a high weight to the pair, the user makes it unlikely that the solution procedure will try to assign the zip code and POD to each other. It should be kept in mind that the solution procedure automatically takes distances between zip codes and POD's into account when making assignments, so distance should not be considered when setting difficulty factors. This option basically converts the distance between centroids to actual travel mileage.

Default settings for travel difficulty factors are read from the file DIFFACT.id if it exists; otherwise all factors are assumed to be equal to one. If the user responds "yes" to the question on changing travel difficulty factors, new values may be entered into the file. Type a zip code, a POD zip code and the new factor on one line separated by spaces. The factor may be any positive number. A factor greater than one implies that travel is of more than average difficulty; a factor less than one implies easier travel.

After travel difficulty factors have been set, the system prepares to begin the solution process. Before proceeding, however, the user is given the opportunity to abort the solution process and return to the top menu by pressing Q. This should be done if the user realizes that some parameter may have been incorrectly specified. Otherwise, by pressing any key other than Q, the solution process will begin. There will be a pause for several minutes while the workload file WORKLOAD.id is read and all possible zip code pairs and their costs are computed. (For a complete mathematical description of the cost calculation, see "The Internal Revenue Service Post-of-Duty Location Modeling System: Final Report".) The zip codes in the workload file are compared with the master list of zip codes obtained from the boundary file. If any zip codes appear in one file but not the other, they are eliminated from consideration by the solution procedure.

It is possible that for some zip code there may be no POD site within the required distance limit. In this case, the solution cannot proceed and an error message will appear on the screen. The user should then either increase the distance limit or set additional potential POD sites.

After costs for each zip code pair have been calculated, a summary is printed giving the total number of zip codes, the total number of possible POD sites (current and potential), and the number of initial POD's (current and fixed). Then the user is prompted to enter the number of POD's desired in the solution. This can be any number from one to the total number of possible POD sites.

The solution computation then begins and passes through four phases, which are outlined below. However, it is not necessary for the average user to understand these phases.

1) Initial Assignment

Zip codes are assigned to the initial set of POD's, and the total cost of the assignment is printed on the screen.

2) Initial Interchange

Each initial POD is examined to see if it can be interchanged with another potential site to give a lower allocation cost. A message is printed on the screen whenever an interchange is made. The result at the end of this phase is a better arrangement of the initial number of POD's. The cost of the new arrangement is printed on the screen.

3) Greedy Heuristic

In this phase, POD's are added to (or deleted from) the previous set until the specified number of POD's has been reached. One POD is added (or deleted) at a time, and it is chosen as the site which, when taken with the previous set, will give the lowest possible allocation cost. Messages are printed on the screen telling which POD's have been added (or deleted) and what the allocation cost is at each step.

At some stage of the solution algorithm, a message may appear saying that a solution is infeasible. This means that for some zip code it was impossible to find a POD site within the specified maximum distance limit. The algorithm will proceed using the last known feasible number of POD's for the final interchange.

4) Final Interchange

In the last phase, the set of POD's determined by the greedy heuristic is examined to see if any POD in the set should be interchanged with one not in the set. The interchanges are listed on the screen along with the final allocation cost.

There is a fifth optional step to the solution process. The system will ask whether lower bounds should be produced to the optimal solution. If the answer is "yes", the system will attempt to obtain a measure of how good the solution is. The greedy and interchange methods are heuristics, that is, they will find very good locations for the POD sites but not necessarily the absolutely best locations. The lower bound procedure calculates an estimate of how close the greedy-interchange solution is to the true best solution. In the course of doing this, the procedure may come across a better solution than the greedy-interchange solution. If so, the greedy-interchange solution is replaced by the new solution.

Colors are then calculated for the solution map, to be displayed later, and the top menu reappears on the screen. At this point, if the user wishes to solve the same problem again with a new number of POD sites, he or she should enter F4 again without doing F3 first. The system will detect that

no new POD initialization was set up and will proceed directly to the solution phase without recalculating all the zip code assignment costs. This allows the same problem to be solved quickly for different numbers of POD sites.

Note: The cost figures produced by the solution procedure are not "real" costs; they are an estimate of the travel cost of working all "optimal" workload (see Section III Part C), as well as the office space and opening/closing costs. These costs are used within the POD location system to compare possible solutions and should not be used outside of the system. The user should also remember that factors other than travel, space, and opening/closing costs should be considered when choosing a POD location, such as the availability of labor and the existence of Economic Development Areas. The user should discuss questions in this area with National Office Facilities Management.

F. Displaying Optimal POD Locations

The F5 function in the top menu is used to display a map showing the solution to the POD location problem determined using the F4 function. First a map of the state outline is drawn, with asterisks indicating the centroids of POD's in the solution. The menu of display options shown in Figure 8 appears on the left side of the screen.

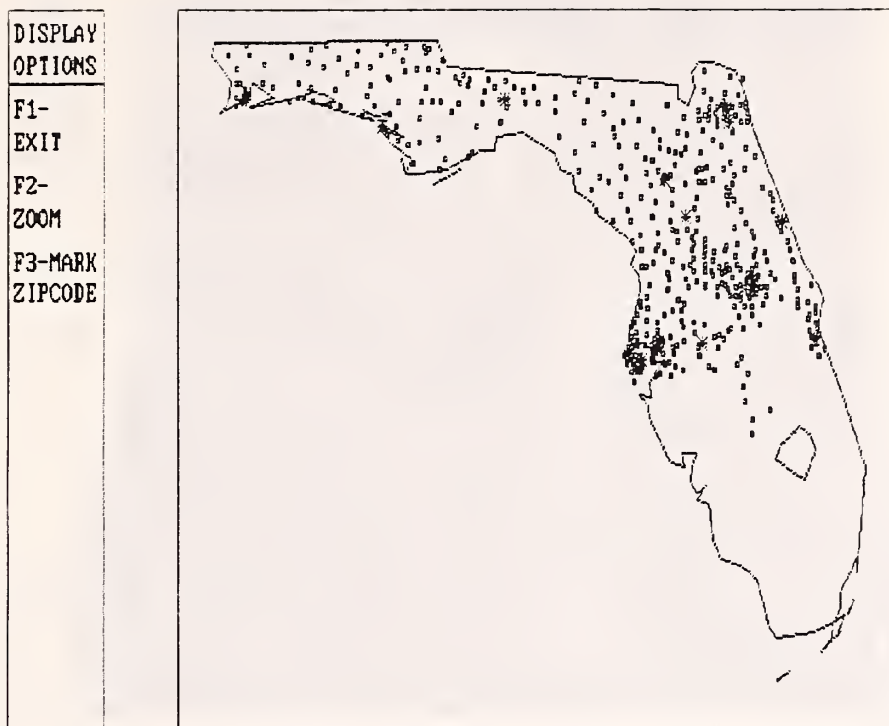


Figure 8. Full state map display menu.

The menu choices are discussed below.

F1 - Exit

Exits from the solution display mode and returns to the top menu.

F2 - Zoom

Zooms in on a specified area of the map to display the solution there. See Part A for a complete description of how to use the cursor to draw a box around the area. A new map showing zip code boundaries in the boxed area will be drawn, and a new menu will appear (see below).

F3 - Mark Zip Code

Allows the user to type in a zip code number and have its location marked on the map. See Part A for more information.

After choosing F2 from the full state display menu, the menu of display options shown in Figure 9 will appear.

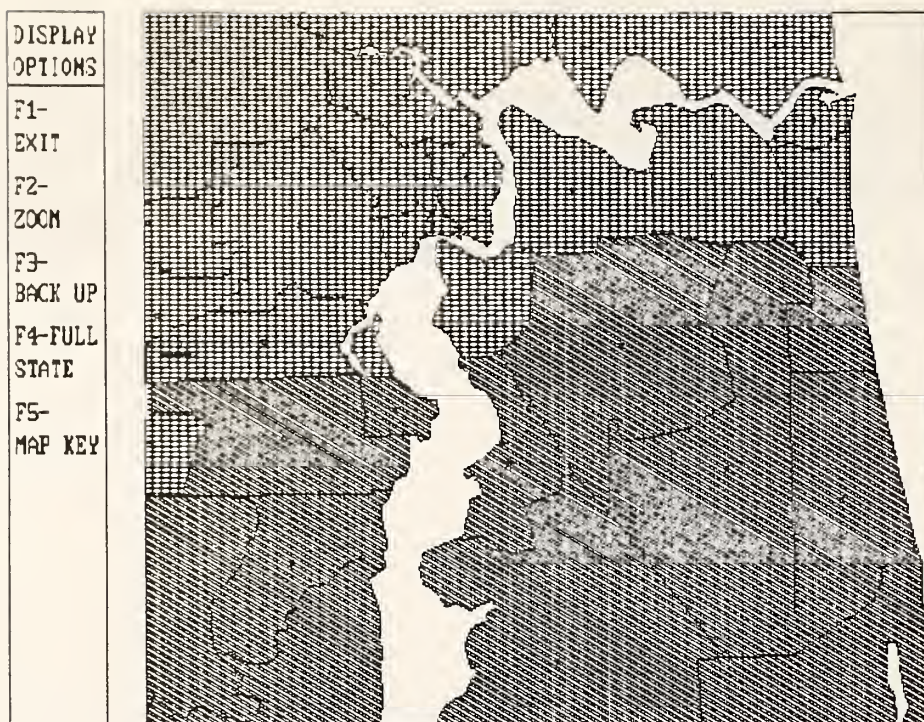


Figure 9. Zip code map display menu.

The options are described below.

F1 - Exit

Exits from the solution display mode and returns to the top menu.

F2 - Zoom

Zooms in on a specified area of the current map. See Part A for a complete description of how to use the cursor to draw a box around the area. The same menu will appear after the new map is drawn, and the user may zoom as many times as desired.

F3 - Back Up

Redraws the previous map and its display menu. Only one level of backing up is allowed.

F4 - Full State

Redraws the state outline map with zip code centroids. The full state display menu also reappears.

F5 - Map Key

Displays the map key shown in Figure 10.

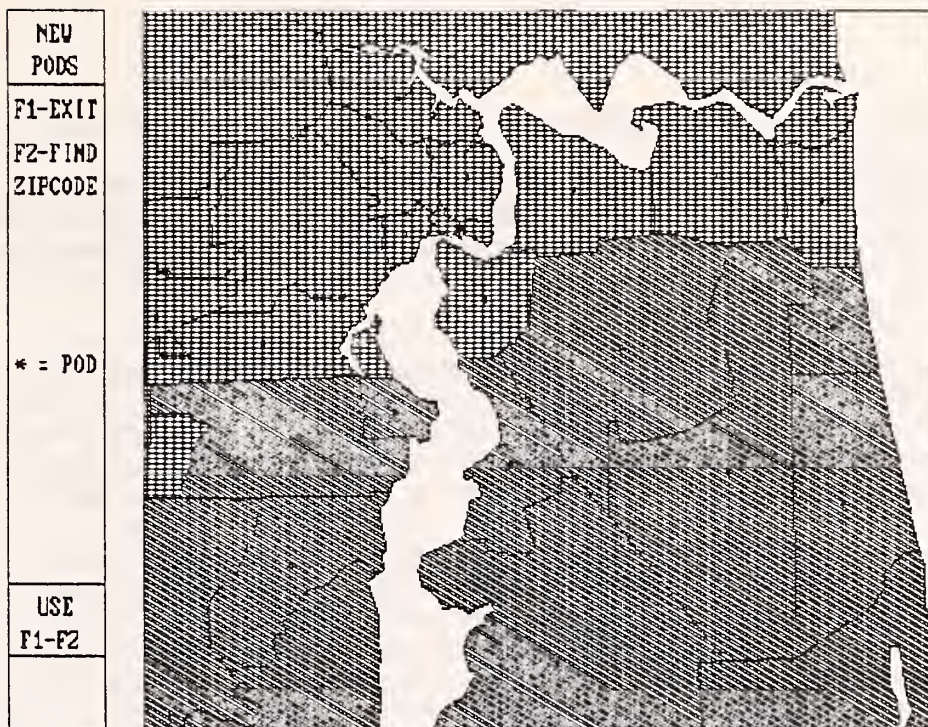


Figure 10. Solution map key.

Zip codes which the solution algorithm determined should be POD sites are marked by asterisks on the map. The solution map will show a POD site and its assigned zip codes all drawn in the same color. (Note: If the file ADJACENT.id was missing from the distribution disks, this map will show only POD sites, with no zip code assignments.) The following options exist on the menu.

- F1 - Exits from the solution key and returns to the menu of display options.
- F2 - Allows the user to find the zip code number of an area on the map located by the cursor. The zip code number is displayed in the lower left corner of the screen. (The procedure for using the cursor to locate a zip code is described in Part A.)

G. Reporting Zip Code and Staff Assignments

The F6 function in the top menu is used to generate a solution report in the file REPORT.id. This file contains a complete summary of the current session. The report does not appear on the screen, but it may be printed out upon exiting from the system or it may be examined later with a text editor such as Wordstar.

The file always contains the date and time of the beginning of the session and a summary of any input data which was used, including initial POD sites and their costs, user options, trip factors and staffing factors. This information is included in the report file even if the user never chooses the F6 function. When F6 is chosen, a section is added to the report which lists each POD in the solution, along with its assigned zip codes, its workload totals, and its prorated share of Exam, Collection and other total staffing. It should be kept in mind that the purpose of the POD location system is to choose optimal locations for POD's in a district, not to find optimal staffing assignments, so the staff numbers reported are only estimates. The estimates are based on spreading the total available staff for the district according to the workload of each POD's zip codes. (Note: If the system assigns more staff to a POD than is physically possible under current space constraints, this indicates the need for an additional POD in that general area.)

H. Exiting from the System

To exit from the POD location system, choose F1 from the top menu. The system will automatically delete several work files which were created during the session. For reference, the names of these files are ERRORS.GKS, TRANSFER.id and SOLUTION.id.

If, during the course of solving a location problem, the user altered any POD site information or any parameters such as the distance limit or the staff totals, the system will ask before terminating whether these changes should be made permanent. If not, the changes will be lost. However, making permanent changes should be done with great caution, since the original PODSITE.id file will be overwritten.

Next, if a printer is attached, the system will ask if the report file should be printed out. This file contains a complete summary of all data used and all activities performed during the current session. (Reports of previous sessions may also be contained in the same file.) If the user does not choose to print the report, the information is still available in a file called REPORT.id. The file may be printed out later or examined with a text editor such as Wordstar.

Note: If the user asks to have the report printed out and instead the message "Bad command" appears, the user's computer probably does not have a path set up for DOS files, so the system could not find the "Print" command. The user should find the directory containing the DOS files and then create a path to this directory (see the DOS manual for more information).

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